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St. Patrick's Day Demonstration

Introduction

When the gas supply for a burner is bubbled through a solution of boric acid in ethyl alcohol, a green color is imparted to the flame. This makes a spectacular demonstration on St. Patrick's Day or any day of the year!

Concepts

- Flame tests
- Atomic emission

Materials

Boric acid, H_3BO_3, 10 g
Ethyl alcohol, CH_3CH_2OH, 100 mL
Erlenmeyer flask, 250-mL
Extension clamp
Glass delivery tubes with a 90° angle, to fit stopper, 2
Glycerin (optional)
Meker burner
Rubber stopper, 2-hole, to fit flask
Rubber tubing, to fit burner and glass delivery tubes, 2
Support (ring) stand

Safety Precautions

Ethyl alcohol is a flammable liquid and a dangerous fire risk. Addition of denaturant makes denatured ethyl alcohol poisonous—it cannot be made non-poisonous. Boric acid is moderately toxic by ingestion, and, in dry form, is a skin irritant. Do not turn the gas on too high to cause the ethyl alcohol to "boil" violently. Make sure the Erlenmeyer flask is secure and cannot tip over. Be very careful inserting the glass tubes into the rubber stopper—use glycerin and safety tips. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information. Wash hands thoroughly with soap and water before leaving the laboratory.

Preparation

1. Prepare a boric acid solution by dissolving 10 g of boric acid in 100 mL of ethyl alcohol.
2. Insert both of the glass delivery tubes into the rubber stopper.
3. Attach a piece of rubber tubing to both glass delivery tubes. Attach one of the pieces of rubber tubing to the gas outlet. Attach the other piece of rubber tubing to the burner gas inlet (see Figure 1).
4. Pour 100 mL of the boric acid solution into the Erlenmeyer flask.
5. Insert the stopper into the flask. The piece of glass tubing connected to the gas supply should be submerged in the boric acid solution. The other piece of glass tubing should not be submerged in the boric acid solution (see Figure 1).

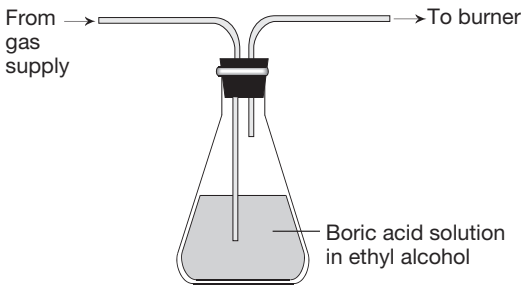

Figure 1.

Procedure

1. Assemble the apparatus as shown in Figure 1 (see *Preparation*). Secure the Erlenmeyer flask to prevent it from tipping over.
2. Turn on the gas supply and light the burner.
3. The flame will burn green!

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. The boric acid/ethyl alcohol solution may be neutralized according to Flinn Suggested Disposal Method #24b.

Tips

- Be careful when inserting glass tubing into rubber stoppers. Be sure to use a lubricant such as glycerin, hand protection, and safety tips.
- Do not light the burner flame until the ethyl alcohol solution has been poured into the flask. Cap the ethyl alcohol bottle and remove it from the work area. Clamp the Erlenmeyer flask and keep the flammable ethyl alcohol solution well away from the flame.
- Make sure that the glass delivery tube leading to the burner is well above the level of the ethyl alcohol solution.
- Do not bubble the gas through the ethyl alcohol solution too fast, which could cause excessive bubbling.
- Turn off the lights in the room to enhance the color of the flame.
- An alternate demonstration is to place a small amount of the boric acid/ethyl alcohol solution in a Pyrex® Petri dish or watch glass and ignite it with a butane safety lighter. The flame will burn green. Perform a flame test in this manner only away from open flames and any sources of ignition.

Discussion

In this demonstration, the gas supply for the flame contains boric acid. In general, when a substance is heated in a flame, the substance's electrons absorb energy from the flame, are promoted to excited energy levels, and then emit light as they relax back down to the ground state. In the case of boron, the emitted light is green. This demonstrates a classic qualitative test for boron.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Systems, order, and organization
Evidence, models, and explanation
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter, transfer of energy
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter, chemical reactions, interactions of energy and matter

References

Bilash, B.; Gross, G.; Koob, J. *A Demo A Day™—Another Year of Chemical Demonstrations;* Flinn Scientific: Batavia, IL, 1998; Vol. 2, p 61.

Earles, T. T. *J. Chem. Ed.* **1991,** *68,* 57–58.

Materials for the *St. Patrick's Day Demonstration* are available from Flinn Scientific, Inc.

Catalog No.	Description
B0137	Boric Acid, Granular, 100 g
E0009	Ethyl Alcohol, 95%, 500 mL
GP3045	Erlenmeyer Flask, 250-mL
AP4592	Tubing Connector, Bent, Flint Glass, 90° Angle
AP8284	Tubing, Rubber, Black
AP1022	Burner, Meker, Gas
AP2316	Stopper, Rubber, Black, Two-Hole, No. 6
AP4524	Safety Tips

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.